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Flikkema, Meindert; Castaldi, Carolina; de Man, Ard Pieter; Seip, Marcel

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Trademarks' relatedness to product and service innovation: A branding strategy approach

Meindert Flikkema[a,*], Carolina Castaldi[b], Ard-Pieter de Man[a], Marcel Seip[a,c]

[a] Vrije Universiteit Amsterdam, School of Business & Economics, Department of Management & Organization, the Netherlands
[b] Eindhoven University of Technology, Department of Industrial Engineering & Innovation Sciences, the Netherlands
[c] Rijksdienst voor Ondernemend Nederland (RVO.nl), The Hague, the Netherlands

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ABSTRACT

The use of trademark data in innovation studies is still limited because as yet no guidelines exist to ascertain which trademarks relate to innovation. This paper proposes that a branding strategy approach may help to identify innovation related trademarks. Companies use distinctive branding strategies for innovation and these branding strategies have important consequences for the design of new trademarks and their application scope. Based on a sample of Benelux and Community trademarks, we find that trademarks for brand creation relate more often to product innovation. In addition, we find negative effects of a trademark's industry scope on its relatedness to product innovation, and of a trademark's geographic scope on its relatedness to service innovation. Our findings bear several key implications for further research towards identifying innovation-related trademarks from a branding strategy perspective.

1. Introduction

Research on the relationship between trademark activity and innovation is in its infancy (Schautschick and Greenhalgh, 2016; Graham and Hancock, 2014). Results from empirical studies so far, however, are promising. They show positive correlations between the firm-level use of trademarks and firm-level proxies of innovation (Allegrezza and Guarda-Rauchs, 1999; Schmoch, 2003; Jennewein, 2005; Jensen and Webster, 2009; Götsch and Hipp, 2012). They also support the view that trademarks may be relevant for measuring innovation, as discussed in the pioneering paper by Mendonöa et al. (2004) and acknowledged by the recent inclusion of trademark counts in rankings such as the EU Innovation Scoreboard (European Commission, 2015).

Most innovation studies, however, still use patent statistics and R&D investments as preferred innovation indicators (Malecki, 2014). The major bottleneck preventing a wider use of trademark-based indicators does not seem to be that only a limited share of trademarks relates to innovation, but even more critically, that no rules of thumb exist to establish which ones. We contend that innovation research can benefit from the information stored in new trademark records and firm-level trademark portfolios for a more systematic understanding of trademarks related to innovation. A trademark portfolio is the result of all choices made by firms regarding trademark filing at national and international offices for intellectual property rights (Sandner, 2009). Trademark similarity to other firm-owned trademarks in terms of words, symbols and aesthetics as well as a trademark's geographic and industry scope are the most important choices and are fundamentally intertwined with the focal applicant's branding strategy (Block et al., 2014).

A quite natural strategy for signaling technological advances or flagging product innovation is brand creation. New brands signal the distinctiveness of firm offers (Aaker, 2007). However, new trademarks in a firm's trademark portfolio may also have been filed for different branding purposes, such as brand modernizing or extension (Sandner, 2009; Block et al., 2014), or as a preemptive registration (Rui, 2013). This paper therefore serves the call from Brexendorf et al. (2015) who make a plea for a better understanding of the relationship between branding and innovation. Hence, our main contribution is to spell out how a branding strategy approach can help to predict a trademark's relatedness to innovation. This approach allows us to interpret information from trademark records in light of the underlying choices of trademark applicants regarding the branding of their innovation.

Our key results are two. Firstly, we studied whether brand creations, in the form of both first trademarks from start-ups and dissimilar subsequent trademarks from all firms related more often to innovation. We find that first trademarks by startups relate most strongly to product innovation. Trademarks mark the start of a business (Vries et al., 2017), hence our results indicate that trademarks are particularly relevant to

* Corresponding author.
E-mail address: m.j.flikkema@vu.nl (M. Flikkema).

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study brand creation for innovation in startups. As Seip et al. (2018) rightfully address, startups are underrepresented in innovation surveys, such as the CIS survey. We also find that dissimilar subsequent trademarks filed for brand creation purposes relate more often to product innovation.

Secondly, we considered the various scope choices a firm made at the time of trademark application, in particular concerning the geographies and industries to be covered. We find that trademarks registered to protect brands with a narrow industry scope relate more often to product innovation, while trademarks protecting brands with a narrower geographic scope related more often to service innovation.

The remainder of this paper is structured as follows. Section 2 reviews the key studies exploring the relatedness between trademark activity and innovation to show the current state of thinking. Section 3 presents hypotheses about the relationship between innovation, branding strategies and trademark application. Section 4 describes our research approach, matched data sources and sample characteristics, while Section 5 presents the results of multivariate regression analyses to test our hypotheses. We end with conclusions, limitations and an agenda for future research into the relatedness between trademarks and innovation while pursuing a branding strategy approach.

2. Studies on trademarks and innovation

Trademark law gives economic agents the opportunity to protect brand names and symbols against imitation. Trademarks identify the origin of goods and services, thereby offering protection to both sellers and buyers (Greer, 1979). They protect against deception and fraud to buyers, and to some extent they protect sellers' monopolies. Strictly speaking, however, trademarks do not protect inventions as patents do, since an inventive step and non-obviousness are not required to successfully apply for trademarks. The primary purpose of trademark protection is to provide incentives for firms to invest in both quality and reputation (Nam and Barnett, 2011). From case studies, we know firms sometimes apply for new trademarks in cases of meaningless or nil differentiation, for exchange reasons (Block et al., 2014), to prolong other Intellectual Property Rights (IPRs) (Statman and Tyebjee, 1981; Rujas, 1999; Jain and Conley, 2014), to leverage brand equity (Kocyigit and Ringle, 2011; Block et al., 2014), to avoid trademark squatting (Helmers et al., 2013), to pack product spaces (Reitzig, 2004), to control franchisees (Ramello, 2006), to support low risk entry in foreign markets (Giarratana and Torrisi, 2010), to enable ingredient marketing (Reitzig, 2004), to protect slogans, or for advertising purposes (Fosfuri and Giarratana, 2009). We can therefore conclude that the use of raw trademark counts in innovation studies has several potential drawbacks in particular for micro-level research.

Nevertheless, trademark data's potential for innovation research has been claimed in a seminal paper by Mendonça et al. (2004), for several reasons. Firstly, trademarks are widely used across all industries of economic activity (WIPO, 2013) and firm sizes (Rogers et al., 2007; Seip et al., 2019). Trademark registration is less costly than patent registration and registration requirements are easier to fulfill. For the UK, Rogers et al. (2007) show that in all industries, the number of SMEs owning trademarks is always higher than those owning patents, with a particularly striking difference in service industries. Secondly, while patents are related to inventions, trademarks capture inventions being commercialized (Nam and Barnett, 2011; Castaldi and Dosso, 2018), because commercial use is a precondition for registration. In this sense, they complement patents as innovation output indicators (Somaya et al., 2007). Thirdly, trademarks also capture non-technological types of innovation, in particular new marketing solutions (Millot, 2009) and service innovation, to make the intangible tangible (Schmoch, 2003). Hence, trademark-based indicators could even substitute patent-based ones in these contexts. Finally, trademarks can be collected systematically from trademark offices[1] and are classified as protecting a good, service or a combination thereof with a detailed classification system: the Nice classification (Economides, 1998; Schmoch and Gauch, 2009). They also represent a meaningful indicator at different levels of aggregation: firm, industry or country.

So far, a few studies have offered empirical evidence that trademarks relate to innovation. As rightly noted by Schautschick and Greenhalgh (2016), establishing a link between trademarks and innovation is challenging, given that it is difficult to measure innovation in the first place. Any test of whether trademarks relate to innovation is bound to rely on proxies. Studies mainly use information from the Community Innovation Survey (CIS), for example Schmoch (2003); Millot (2012) and Götsch and Hipp (2012). Thus, most studies report indirect evidence in the form of firm-level or industry-level correlations between trademarking activities and innovation (see Table 1). In addition, studies typically use raw trademark counts or dichotomies like the firm-level (yes/no) usage of trademarks. Remarkably, hardly any study in this area has exploited information from trademark records beyond this basic information. Two empirical studies report direct evidence at the trademark level. In a longitudinal case study Malmberg (2005) focuses on the firm-level propensity to trademark product innovations and distinguishes between general trademarks (company name or marketing slogans) and trademarks signaling new products and services. Flikkema et al. (2014) look at the motives behind the registration of a sample of Benelux trademarks and the trademark-level relatedness to innovative activity and output. The preliminary conclusion of these studies is that the relationship between trademark activity and innovation is highly dependent on the industry, market and innovation type (see also Jensen and Webster, 2009).

Finally, conceptual work by Davis (2006) offers insights on firm-level strategies behind trademark application for innovation purposes: "Most incremental innovations represent only very small changes over existing goods, or new combinations of existing goods, neither of which represent the kind of 'inventive step' necessary to qualify for patent protection" (Davis, 2006, p. 11). That is why the 'standalone' use of new trademarks makes particular sense for incremental innovations, to signal newness and to enhance the perceived differentiation of new offers (Flikkema et al., 2014).

We can conclude that although there is evidently a relationship between trademark registration and innovation, we need to better understand when trademarks are related to innovation, and to which innovation types. In the following section, we therefore propose a branding strategy approach to identify trademarks related to product or service innovation. The basic idea is that distinctive branding strategies for innovation lead to specific trademark application choices.

3. Branding strategies as predictor of innovation-relatedness

3.1. Innovation, branding and trademark application: a conceptual framework

Successful brands communicate with consumers through brand stories (Chiu et al., 2012). The brand story plays an important part in helping consumers make sense of the brand. We therefore conceptualize brand creation strategies as 'the creation of new, distinctive brand logos and the crafting of compelling brand stories'. According to the leading branding scholar David Aaker (2007) an innovation should be branded distinctively when it is a significant advance, when customers care and when it will merit investment over time. If companies act this way, then one may expect that brand creation strategies for innovations translate into the filing of new, dissimilar trademarks. Fig. 1 gives a general

[1] Since 1996, European firms can apply for Community Trademarks at the EUIPO and an online database enables to search all registered or pending marks.

Table 1
Studies exploring the relationship between trademarks and innovation activity.

Source	Citation	Nation coverage	Innovation proxy	IP rights covered	Proxy of IP usage	Sector coverage	Key results
CIS survey	Schmoch (2003)	Germany	sales share of new products and services	trademarks, patents	firm-level usage (y/n) of patents and trademarks	manufacturing and services industries	Significant correlation between innovation and trademark use for KIBS.
CIS III survey	Mendonça et al. (2004)	17 EU member states	product innovation	trademarks, patents	firm-level usage (y/n) of patents and trademarks	nation aggregated data	Innovative firms consistently use more trademarks and patents.
MIBS survey	Jensen and Webster (2009)	Australia	product, process, organizational and marketing innovation	trademarks, patents, design rights	firm-level trademark and patent activity	manufacturing and service industries	Product innovation is correlated with patents and trademarks, as well as R&D, but not with design rights. Process and Organizational innovation show nil or negative correlations with IP activity. Marketing innovation only slightly positively related to TM activity.
NSF, USPTO	Daizadeh (2009)	USA	R&D spend	trademarks, patents	number of IP rights applied for and granted/registered	nation aggregated data	The correlation between R&D spend and the number of trademark filings at the national level is stronger than the correlation with the number of patent applications.
Orbis, PATSTAT, OHIM, INPI	Millot (2012)	France	product, process, organizational and marketing innovation	trademarks, patents	firm-level usage (y/n) of patents and trademarks	manufacturing and services industries	Product and marketing innovations are determinants of trademark activity, while process innovation and organisational innovation are not.
CIS IV and KIBS survey	Götsch and Hipp (2012)	Germany	sales share of new products and services	trademarks, patents, design rights, copy rights	firm-level usage (y/n) of IP rights	low tech and high tech manufacturing, KIS, KIBS and other service industries	Significant correlation between innovation and trademark use in high-tech manufacturing and KIBS.
TIS survey	Flikkema et al. (2014)	Belgium, Netherlands, Luxembourg	product, process, service, organizational and marketing innovation	BTMs, patents, design rights, growers rights, copy rights	case-level bundling of the various IP rights with the trademarks studied	manufacturing and services industries	60% of all BTMs refers to innovative activity, predominantly to product, service delivery and marketing innovation.

overview of the relation between innovation, branding strategies and trademark application practices. Trademarks protect the brand logo, including brand name and brand esthetics. The design of one or more trademarks would cover a brand logo completely. Other trademarks may be filed to protect key elements of the brand story such as slogans (Petty et al., 2010). A further relevant element is brand scope. Brand scope choices concern both the geographic scope of brands (e.g. Townsend et al., 2009) and their industry scope (e.g. Sanchez, 2004). Information about both brand scope dimensions are registered in trademark applications. The Nice classes covered in a trademark record relate to a brand's industry scope, while the trademark system (national versus international) reflects choices concerning a brand's geographic scope.

3.2. *Trademarks filed for brand creation as predictor of innovation-relatedness*

Trademarks are filed for various reasons (Flikkema et al., 2014; Castaldi, 2018), but predominantly to avoid brand imitation and blurring. Block et al. (2014) distinguish different trademark-filing strategies. They use word and Nice class similarity between trademarks at the portfolio level to qualify new trademark filings. According to Block et al. (2014), brand creation is required if a firm wants to tap into new market segments where they cannot capitalize on the equity of parent brands or when this equity is at risk due to potential brand dilution. Dissimilar trademarks tend to convey unrelated, dissimilar and hence distinctive offers supporting brand creation. It is therefore reasonable that when a firm-level trademark portfolio is expanded with a verbally or visually dissimilar trademark, we can expect diversification or innovation efforts taking place. Or in terms of Aaker (2007, p.13): 'only significant advances legitimize the development of distinctive brands'.

Alternatively, brand extending strategies are precisely aimed at exploiting spillover effects from established brands. Consider for example *McKinsey Solutions*, a figurative trademark used to support the branding of McKinsey & Company's service line extension. The figurative trademark *WAVE*, also owned by McKinsey, protects a product brand created to identify a new program management tool – a McKinsey solution – that supports transformation and change programs. As this is a standardized rather than a customized solution, which is also licensed to customers, the brand creation also serves the purpose of separating this standardized service from the company's core services to avoid brand blurring (Castaldi and Giarratana, 2018).

Brand modernizing, on the other hand, can be supported through trademark filing practices aiming to rejuvenate existing brands (Sandner, 2009) for various reasons: to discard undesirable associations in changing environments, signal revitalization and ongoing market presence, improve the fit with a product's life cycle, appeal to contemporary preferences and tastes in aesthetics (Diamond, 1969), or to stretch the number of perceived brand attributes (Henderson and Cote, 1998) or their quality (Boush, 1993). Brand modernization does not have any clear link to the signaling of new products or services.

Among the brand creations are also, by definition, first trademarks by start-ups. A substantial share of the first-time trademark applications will be from start-ups. Their trademarks mark the start of a business. It is reasonable to expect start-ups to aim for brand creation for innovation purposes because start-ups are considered an important 'innovation model' (Freeman and Engel, 2007). One may expect that start-ups will apply for first trademarks related to both incremental (Davis, 2006) and radical innovation for reasons of a lack of resources to apply for other IPRs (Flikkema et al., 2014), but also to signal their invention's market potential and entrepreneurial spirit to venture capitalists (Vries et al., 2017). For these reasons, we also expect a relation to innovation for first trademarks by start-ups, but not for first trademarks by mature firms. We therefore hypothesize:

Hypothesis 1. *Trademarks supporting brand creation, including dissimilar*

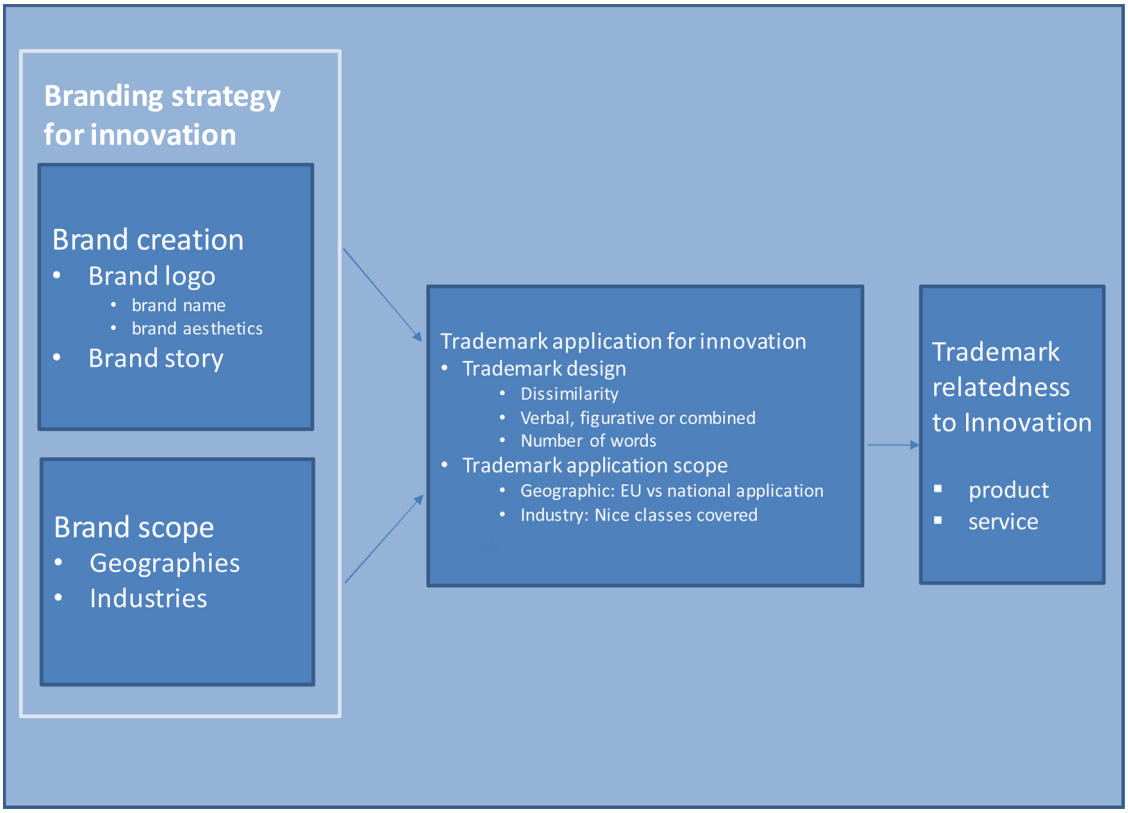

Fig. 1. Conceptual framework.

new trademarks by all firms and first trademarks by startups, are more frequently related to innovation than the ones filed for all other purposes.

Mature firms may also apply for a *first* trademark, but those will not be included in our data as a measure for brand creation. Such trademarks are less likely to relate to innovation. First, brand imitation in their own or adjacent industries might trigger firms to engage all of a sudden in trademark application, for myopic motives (Castaldi, 2018). More rationally, being accused of trademark infringement might lead to brand (re)design and trademark application, to avoid future litigation and lawsuits. Second, brand licensing, franchising or export considerations (Giarratana and Torrisi, 2010; Jayachandran et al., 2013) may also play a role. Third, it might be an attempt to leverage the value of (in)tangible assets (Flikkema et al., 2014), for example just before selling the firm or in the build-up to divesting a non-core business. Fourth, entrepreneurs might have been uninformed about the possibilities of the IPR system in the start-up stage and also brand equity growth might explain a firm's late start with building a trademark portfolio. Trademark application is then a consequence of entrepreneurial success (Fink et al., 2018) and the protected brand is flourishing. Brand creation is not expedient.

3.3. Trademark application scope as predictor of innovation-relatedness

3.3.1. Geographic scope

Trademarks are geographically bound, as their validity is constrained by national boundaries. Yet, the existence of Community trademarks (CTMs) allows companies to apply for the same trademark in several member states at once in the EU. However, application at the European level is more complex, and fees are typically proportional to the number of countries covered. When companies opt for a CTM, they are likely to either diversify internationally or they might be 'born globals' (Madsen and Servais, 1997). Hitt et al. (1997) show for medium sized and large manufacturers that international diversification is positively related to firm innovation. They argue that innovation is either a reason for internationalization, to earn a reasonable return on investments in radical innovation, or a consequence. 'Internationally diversified firms have access to more and different resources and, because of the larger markets and potentially greater returns, have more resources to invest in innovation' (Hitt et al., 1997, p.774). Expansion into international markets provides opportunities for greater returns on innovations and reduces the risk of failure due to the additional number of markets in which the innovation may be applied. Both arguments support a positive relationship between the geographic scope of trademarks and the relatedness to product innovation. We therefore hypothesize that:

Hypothesis2a. *Trademarks with a broader geographic scope are more likely to relate to product innovation than other new trademarks.*

A decisive argument for hypothesizing a negative relationship between a trademark's geographic scope and its relatedness to service innovation, is that the market introduction of service innovations often starts with a national, regional or local try-out. Due to the difficulties in exporting which are magnified by the unique characteristics of services, many service innovations are prototyped and introduced locally, in pilot runs (Magnusson et al., 2003), with lead users (Schuhmacher and Kuester, 2012) or on the job (Flikkema et al., 2007). Subsequently, after initial success and various cycles of continuous improvement (Terziovski, 2002), an international rollout might be planned. Den Hertog et al. (2010) and Charitou and Markides (2002), however, argue that service firms often struggle with up-scaling new services, also because service innovation is frequently an ad hoc process (Gallouj and Weinstein, 1997). Moreover, from the branding literature we also know that service firms tend to adopt a corporate brand approach to the management of their brand architecture, having a propensity to rely on one overarching brand (Devlin, 2003). This may imply that particularly

subsequent trademarks with a higher geographic scope are less likely to relate to service innovation. One may argue that in these cases new trademarks 'just' signal geographic expansion or the applicant's intention to adapt to local needs, peculiarities or habits (Pike, 2013). The applicant may also try to benefit from positive attributes of city, region or nation 'brands', i.e. associations to certain geographies. Consequently, we hypothesize that:

Hypothesis 2b. *Trademarks with a broader geographic scope are less likely to relate to service innovation than other new trademarks.*

3.3.2. Industry scope: trademark breadth and Nice class types

A trademark is also characterized by a certain *industry scope*. With industry scope, we mean the number -typically referred to as 'breadth'- and type of Nice classes covered by a single trademark (Sandner and Block, 2011). Note that the 45 Nice classes aim to cover all economic activities: 34 Nice classes cover goods, while Nice classes 35–45 cover services. Sandner and Block (2011) and Melnyk et al. (2014) use Nice breadth as an indicator of the value of trademarks, which might be associated with a higher likelihood of relating to innovation. Sandner and Block (2011, p. 973), however, describe their doubts on the latter: "Assessing the words or signs that trademark rights protect reveals that those trademarks associated with few classes tend to protect brands for single products or narrow product lines, for example Microsoft Office 2000 or iPod. By contrast, trademarks like Daimler or PlayStation are awarded to many classes and seem to protect wider product lines or so-called umbrella brands."

Due to the pricing policy at IPR offices in Europe[2] and for myopic me-too reasons (Flikkema et al., 2014), many trademark applicants seem to select three Nice classes. To avoid trademark opposition, or because a trademark covers a very specific and distinctive offer, some applicants may decide to file their trademark in fewer classes or more specific (product or service only) classes. Some applicants might also be uninformed about the 'three for one' pricing policy of trademark offices. However, firms may also choose to apply for trademarks in more than three Nice classes in order to avoid trademark dilution, anticipate future entry in adjacent markets, or to license a brand name in other industries. These are non-innovative activities. We therefore hypothesize that:

Hypothesis 3a. *Trademarks with a lower breadth are more likely to be innovation related than other trademarks.*

In addition, one may expect that trademark applications filed in product or service Nice classes only are related more frequently to product or service innovation than trademarks filed in both product and service Nice classes. We know from case studies (e.g. BTM application no.1201961) that for some service innovations trademarks are filed in combinations of software (Nice 9), business services (Nice 35) and software licensing (Nice 42) classes. However, we did not find evidence, neither in case studies nor in the servitization literature that manufacturers tend to redesign their brand(s) significantly, when they start offering product-service-combinations. We therefore expect that combinations of product and service classes are predominantly used to emphasize brand attributes, are related to new slogans, or a consequence of the pricing policies of IP offices. We illustrate this with examples from the trademark portfolio owned by Miele, a German provider of high-end domestic appliances and commercial equipment. Consider for example the *Miele Professional* trademark (CTM application no. 0053282232) emphasizing professionalism in both products (Nice 7 and 11) and services (Nice 37) and the *Miele immer besser* slogan (CTM application no. 011998408), which is filed in Nice 7,8,11 and 37 (Repair and Maintenance services), while Miele trademarks evidently related to innovations such as *Intelligent Steam* (CTM application no. 005501499) or *NoSmell* (CTM application no. 005862941), are all just filed in Nice classes 7,9 and 11. We therefore hypothesize:

Hypothesis 3b. *Trademarks filed in product (service) Nice classes only are more likely to relate to product (service) innovation than other trademarks.*

4. Research design

4.1. Data collection methods

To test the hypotheses we collected a sample of registered trademarks for which the relatedness to innovation can be assessed and predicted. Therefore we first selected all −28,960- unique BTM and CTM applicants, starting from all 19,348 BTM and 88,200 CTM applications in 2009, on the condition that at least one of their trademarks was ultimately registered within two years after the initial filing. Second, we distributed an on-line survey based on the availability of applicants' e-mail addresses. The list contained 12,688 unique e-mail addresses of *pro se* filers and e-mail addresses provided by trademark attorneys, who registered the 2009 BTMs and CTMs on behalf of clients. Our sample contained 1015 trademark applications, either for a BTM (n = 456) or a CTM (n = 559) filed in 2009. In the Benelux, Novagraaf, by far the largest firm providing trademark services, with an overall market share of 15.3% in 2009, provided nearly all the e-mail addresses of the 2009 BTM applicants in their client base, which partly explains the overrepresentation of BTMs. We also tested for a Novagraaf effect with a Novagraaf dummy and found that their trademarks more frequently related to product innovation. However, in multivariate analyses we did not find significant Novagraaf effects, hence we dropped the respective dummy.

If an email address of a 2009 BTM or CTM applicant related to more than one trademark, we randomly selected the trademark for which the respondent had to answer the survey questions. This potentially implied a selection bias if trademark application by frequent filers more or less frequently related to innovation efforts. Though it is a potential source of bias, we have no reason to believe that the trademarks of applicants who did not register their email address in the trademark databases of European Union Intellectual Property Office (EUIPO) or the Benelux Office for Intellectual Property (BOIP), had a structurally different relation to innovation than other trademarks in the 2009 population. Trademark law does not dictate e-mail registration, this is probably why the availability of email addresses is limited to about 40%.

We compiled a survey including questions on the respondent's structural characteristics (e.g. firm size & maturity, industry), on the process of trademark application (motives, timing, strategies of combining trademarks with other IPRs), and on the relatedness of trademarks to innovation, largely based on the innovation definitions in the OECD Oslo manual (OECD, 2005). The survey was sent by EUIPO and BOIP, and was available online between July 18, 2012 and January 16, 2013. It was electronically linked with the IPR offices' databases, which enabled the respondents to inspect the details of their trademark filings while answering the survey. Overall, 8 percent of the 2009 trademark applicants (= 1015/12,688) which could be contacted by e-mail completed our survey. Although the response rate was limited, the sample size is substantial, compared to previous survey studies into the motives for trademark application (Flikkema et al., 2014; Block et al., 2015). Nishimura et al. (2016) propose not to discuss sample sizes, but to test whether responders and non-responders differ on fully observed characteristics, which we did for firm size, volumes in Nice classes, industries and trademark types. We present the results in subsection 4.2. For the trademarks in our final sample, we complemented our primary data with secondary data on each trademark. We retrieved the full trademark portfolios at BOIP and EUIPO. Each trademark record contained several pieces of information, of which we exploited: the

[2] Note that pricing schemes at trademark offices make registration in three Nice classes as costly as in only one class. This explains why the number of Nice classes only makes sense when higher or lower than three.

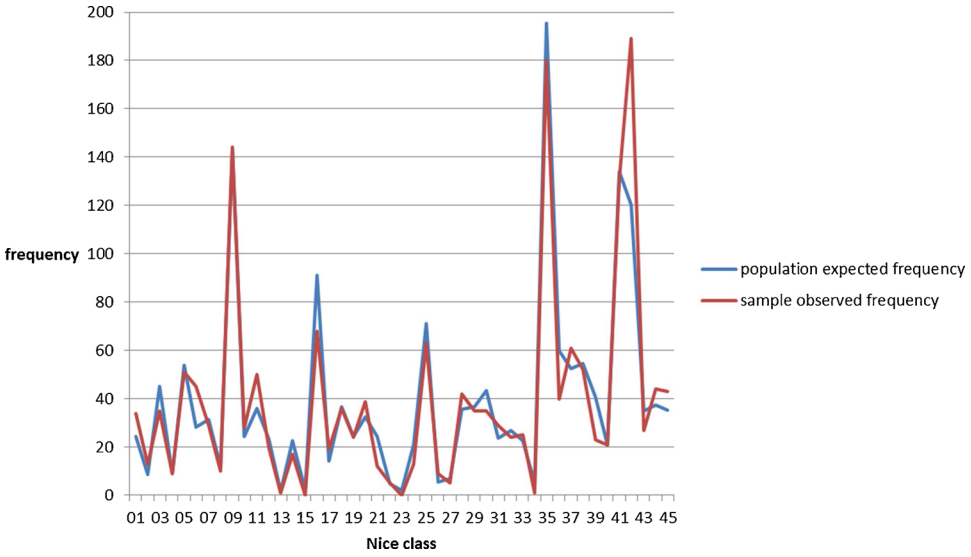

Fig. 2. Sample and population distribution over the Nice classes.

applicant name, and date of filing, the trademark description in words and/or graphics, the trademark type and the Nice classes covered.

4.2. Validity checks

We checked several aspects concerning the representativeness of the sample and the quality of the responses. First, we compared the distribution of the sample trademarks over the Nice classes with the population distribution. Fig. 2 shows the trademark volumes in all Nice classes based on the EUIPO and BOIP databases (population expected frequency) and the sample dataset (sample observed frequency). The pattern was rather similar for both frequencies. We checked whether there was a relationship between the representation of Nice classes and the relatedness of trademarks to innovation in our sample. Nice classes where trademarks had a strong relatedness of trademarks to innovation could have been overrepresented because the survey invitation text touched upon the topic of innovation. The three Nice classes that were most overrepresented (6, 11 and 2) showed somewhat higher relatedness to product innovation, while the three that were most underrepresented (16, 35 and 36) had a higher relatedness to service innovation. This implies that our sample was slightly biased towards product innovation and against service innovation.

Second, we also compared the number of verbal and figurative trademarks in our sample with the numbers expected in the population. Both in the BTM and CTM sub-samples, the share of verbal and figurative trademarks almost equaled its equivalent in the population. Third, we performed additional validity checks using other IPR data sources. The patent applications of all the respondents in the sample who claimed to have filed one or more patents along with the trademark were verified by tracing the patents back to the European Patent Office (EPO). We could confirm the registration of patent applications for 22 of the 29 respondents (75%) in the BTM sample who claimed to have filed patents. For the 114 respondents in the CTM sample claiming to have filed one or more patents, this percentage was even higher: 80%. Remarkably, most of the matched patent applications in both the BTM and CTM samples were European rather than national patent applications. This is an indication that the innovations involved have a significant value because the costs incurred for a European patent application are much higher than an application at a national patent office. Fourth, from previous studies we know that firm size is a covariate of innovation (Shefer and Frenkel, 2005) and IPR strategies (Arundel, 2001; Leiponen and Byma, 2009). We therefore compared the firm size distribution –for Dutch BTM applicants only- in our sample with the firm size distribution in the whole BTM population: all Dutch firms with BTM applications in 2009 (Snoei et al., 2013). No significant differences were found. Since the number of Dutch CTM applicants is limited ($n = 20$), we did not test for sample versus population differences here. We also tested for industry differences between the BTM subsample and the population and found a bias towards the share of manufacturing firms in the sample of 20%. This means that manufacturers were overrepresented in the sample. Finally, we considered the risk of common-method bias as limited because we used both information from trademark records and a distributed survey. The trademark design and scope information was retrieved from the trademark records, while we used the survey for collecting information about the independent variable. Of course, unobserved characteristics might still bias our sample, but these checks tackled all the observed characteristics we could exploit.

4.3. The definition of variables

Table 2 reports the definitions of all our main variables, and descriptive statistics in the original and final sample, the one used for the regression analyses.

4.3.1. Dependent variable

We focused on two types of innovation for which we found the highest proportions of respondents claiming a relationship with their trademarks, namely product (37.9%) and service innovation (20.6%). The survey question asked trademark owners to indicate whether the specific trademark related to a 'new or significantly improved product', or a 'new or significantly improved service', following the definitions of the Oslo manual (OECD, 2005). Additionally, we used the information from another survey question which asked the respondent to indicate whether their innovation was: (1) new to our firm, (2) new to the market where we compete, (3) new to our industry, (4) new to the world, (5) not applicable. As new to the firm innovations are more about diffusion than actual innovation, we opted for a stricter definition of product and service innovation (resulting in 29.6% and 16.9% as the shares of trademarks relating to product and service innovation respectively). Our dependent variable was a dummy, taking the value of 1 whenever the respondent claimed that the trademark related to a new product or service and the innovation was judged as being at least new to the market and a value of zero when they did not relate to innovation or related to new to the firm innovation.

Table 2
Definition of our main variables and descriptive statistics in the original sample and final sample. All variables are dummy variables except for the number of words.

			Original sample			Final sample		
Variable	Category	Definition	N	Mean	Std. Deviation	N	Mean	Std. Deviation
Innovation	Product innovation	Trademark related to a new product, at least new to the market	1015	0.296	0.457	656	0.326	0.469
	Service innovation	Trademark related to a new service, at least new to the market	1015	0.169	0.375	656	0.139	0.346
	Non-innovation	Trademark did not relate to any innovation or only to a new-to-firm innovation	1015	0.295	0.456	656	0.335	0.473
Branding strategies								
TM design	First trademark by mature firm	Trademark was the first filed and the applicant is a mature firm	910	0.256	0.437	656	0.279	0.449
	First trademark by startup	Trademark was the first filed and the applicant is a startup	910	0.300	0.459	656	0.306	0.461
	Brand creation	Trademark is dissimilar to prior marks filed by the applicant	1015	0.259	0.438	656	0.279	0.449
	Brand extension	Trademark is similar to prior marks filed by the applicant	1015	0.120	0.325	656	0.119	0.324
	Brand modernizing	Trademark modernizes prior marks filed by the applicant	1015	0.018	0.132	656	0.016	0.124
	Word mark	Word mark vs combined mark	999	0.514	0.500	656	0.551	0.498
	Figurative	Figurative mark vs combined mark	999	0.255	0.436	656	0.237	0.426
	No. Words	Number of words of the trademark (min = 1, max = 9)	998	1.819	1.336	656	1.791	1.298
TM scope	Geographical scope	Dummy indicating whether the TM was filed as CTM instead of BTM	1015	0.551	0.498	656	0.569	0.496
	Industry scope:							
	Nice breadth	Trademark was filed in more than 3 NICE classes	999	0.155	0.362	656	0.155	0.362
	Only product Nice	Trademark was filed in product Nice classes only	999	0.364	0.481	656	0.364	0.481
	Only service Nice	Trademark was filed in service Nice classes only	999	0.283	0.451	656	0.283	0.451
	Popular Nice	Trademark was filed in NICE classes 9, 35, 41 or 45	999	0.607	0.489	656	0.607	0.489
Other variables from survey/matched data								
Firm size	Micro firm	Applicant was firm with less than 9 employees	968	0.574	0.495	656	0.370	0.483
	Small firm	Applicant was firm with 10-49 employees	968	0.190	0.393	656	0.192	0.394
	Medium firm	Applicant was firm with 50-249 employees	968	0.100	0.300	656	0.101	0.302
	Large firm	Applicant was firm with more than 250 employees	968	0.135	0.342	656	0.129	0.336
Firm market scope	B2B	Dummy indicating if the main clients were business clients	910	0.725	0.447	656	0.750	0.433
	B2C	Dummy indicating if the main clients were final consumers.	910	0.466	0.499	656	0.460	0.499
Other TM properties	Attorney support	Applicant used the support of an attorney	1015	0.229	0.420	656	0.211	0.408
	Combination with patent	Trademark filing was combined with a patent application.	1015	0.136	0.343	656	0.137	0.344

4.3.2. Branding strategies

We started from the procedure proposed by Sandner (2009) and used in Block et al. (2014) to classify new trademark filings. The procedure considered two independent dimensions: *industry scope* referred to the Nice classes covered by the trademark and *linkage* referred to the degree of verbal or visual similarity between the focal trademark and those already in the applicant's portfolio. Both dimensions could be captured using information from trademark records after collecting all prior trademarks registered by the firm. We followed Sandner's procedure when individually inspecting all trademarks in each applicant's portfolio. All trademarks were assigned to one category from Sandner's classification of filing strategies.

If the focal trademark had no similarity to any other trademark owned by the applicant, we classified its filing as brand creating. Brand extensions were instances where the new trademark had some recognizable degree of similarity, i.e. sharing the root or evident connection, but where the industry scope differed. Instances where the new trademark almost overlapped with an existing one, or had at least a very strong degree of word similarity and the same industry scope as prior trademarks, were considered as brand modernizing. We deviated from Sandner's procedure in two ways. Firstly, we also considered figurative trademarks, whereas Sandner's automated procedure only dealt with word marks. Secondly, we left brand-hedging strategies aside and did not distinguish between brand creation with multiple filings on the same date and brand creation with a single trademark filing. Moreover, Sandner's procedure cannot be applied to first trademarks, for which no prior reference exists. We distinguished between first trademarks by startups and by mature firms, taking the latter as our baseline category. We make this distinction between startups and mature firms only for Hypothesis 1, since we have arguments from prior research to expect differences.

Trademarks can be any kind of symbols, the most common being word, figurative and combined word and figurative marks. We classified the trademarks in our sample also according to these three types and for word marks we also counted the number of words included (number of words ranged from 1 to 9).

4.3.3. Trademark application scope

We distinguished two scope dimensions of trademarks: 1) geographic scope and 2) industry scope. The geographic scope was a dichotomy with two possible values, representing two different trademark jurisdictions: BTM or CTM. Evidently, the geographic scope of CTMs exceeded the BTM scope, because CTMs provide trademark protection in all EU member states, while BTMs just cover the Benelux region. The industry scope captured both the number and type of Nice classes covered by a trademark (= trademark breadth). Given the pricing policy, we operationalized breadth as a dummy equal to one if the trademark covered more than 3 classes. We also defined dummies to indicate whether the trademark covered either product only, services only Nice classes, as opposed to both product and services. For both scope dimensions, in line with our hypothesis development, we estimate effects regarding all firms, without separating startups and mature firms.

4.3.4. Control variables

Other explanatory variables included variables stemming from survey questions. We controlled for firm size, measured as a categorical variable based on the number of employees. We defined dummies for the main size categories as indicated in Table 2. We also knew whether the applicant considered itself a start-up or a mature firm. Additionally, controlling for a B2B or B2C market orientation has been proposed by Malmberg (2005), who stated that brand management is a different challenge in end markets compared to intermediate markets. Our survey, therefore, included a question to capture a firm's market scope: respondents could indicate 'delivering products and/or services to commercial organizations: business to business' and/or 'to customers in end-markets: business to consumer', next to 'non-profit organizations' (B2NP).

The survey also asked respondents whether they applied for a patent for the same object covered by the focal trademark. When investigating the trademark-innovation relatedness, we could not ignore the role of patents. Flikkema et al. (2014) already demonstrated that the combination of trademarks and patents is more likely to relate to innovation. Trademarks are often used as complements to patents (e.g. Conley et al., 2013; Zhou et al., 2016): patents protect the inventive component, while trademarks protect a commercialized product/service in the marketplace (Nam and Barnett, 2011) or trademarks allow patent prolongation. Notice that trademark and patent matching at the project level is not information that is typically available. Hence, we were specifically looking for predictors that could act as alternatives for that information.

4.4. Methods of analysis

The aim of our analysis was to investigate trademark and applicant characteristics with a higher explanatory power to disentangle trademarks related to innovation from trademarks not related to innovation. Given this aim and our focus on both new products and new services, we opted for estimating multinomial logistic regressions (Hosmer et al., 2013) where the dependent variable could take three distinct values: (1) relatedness to product innovation, (2) relatedness to service innovation, (3) no relatedness to innovation. Estimation of a multinomial model requires observations to be categorized in only one of the possible categories. As our sample included trademarks referring to more types of innovation and also trademarks referring to both service and product innovation, we selected all the observations corresponding with the three independent categories defined in our dependent variable. Hence, we excluded cases where the respondent indicated that the innovation related to both product and service innovation and we identified the 'no innovation' category as those trademarks where the respondent reported that the trademark did not refer to any innovation or only referred to new-to-firm innovations of any type. We used the 'no innovation' category as our baseline for the multinomial regression and presented estimated coefficients for the product and service innovation categories. To gauge the models' goodness of fit, we reported the Nagelkerke R^2 measure and the prediction rates from the classification table underlying the estimated model (Hosmer et al., 2013).

5. Empirical results

5.1. Descriptive analysis

Along with the descriptive statistics reported in Table 2, we checked the pairwise correlation among all variables in the same sample used for the multivariate regression, (see Table 3). The relatedness of a trademark to product and service innovation was significantly correlated to most of the indicators of trademark application choices. Interestingly, the sign of the correlation was often opposite for product *vs* service innovation. This was also the case for the variable capturing patent combination. As expected, joint trademark and patent application positively correlated with product innovation, while there was a significant negative correlation in the case of service innovation. Successful patenting in services might be predominantly a consequence of expanding a firm's technological options (Hertog, 2000; Blind et al., 2003). These technological options might predominantly lead to process innovations, e.g. the digitalization of delivery processes. The geographic and industry scope dimension significantly correlated, again in opposite directions for a product focus *vs* a service focus. As for attorney support, the correlation coefficients indicated that companies filing trademarks for brand extensions or modernizing were very likely to use attorneys, while small firms and startups were very likely not to. The correlation was instead not significant for first trademarks by mature

Table 3
Correlation analysis of the variables used in the regressions (sample of n = 656): Pearson correlation statistics, together with the p-values. */**= correlation is significant at the 0.01, 0.05 level (2-tailed).

1. Product innovation	1																					
2. Service innovation	-.279**	1																				
3. FIrst TM mature firm	−0.052	−0.003	1																			
4. First TM startup	−0.063	.160**	−.400**	1																		
5. Brand creating	.077*	−.113**	−.388**	−.414**	1																	
6. Brand extending/ modernizing	0.043	−0.057	−.247**	−.264**	−.256**	1																
7. Word mark	0.012	0.001	−0.057	−0.037	.080*	0.022	1															
8. Figurative	0.026	0.019	.140**	−.099*	−0.029	−0.019	−.616**	1														
9. Number of Words	−0.051	0.022	0.018	0.029	−0.045	0.000	−0.038	0.064	1													
10. Geographic scope	.085*	−.098*	0.074	−.142**	0.072	−0.005	.082*	.484**	0.072	1												
11. Nice breadth	−.116**	0.025	−0.048	−0.035	0.051	0.043	−.105**	.094*	−0.012	0.001	1											
12. Only product Nice	.272**	-.287**	0.070	-.189**	.091*	0.036	0.020	.084*	0	.188**	-.234**	1										
13. Only service Nice	−.362**	.296**	0.007	.209**	−.142**	−.097*	0.037	−.133**	−0.019	−.194**	−0.043	−.494**	1									
14. Popular Nice	−.203**	.197**	−.081*	.106**	−.087*	.082*	−0.034	−0.049	.083*	−.093*	.245**	−.702**	.386**	1								
15. Micro firm	−0.057	.152**	0.008	.380**	−.239**	−.203**	0.007	−.092*	0.013	−.246**	0.015	−.130**	.133**	.080*	1							
16. Small firm	0.005	−0.045	.112**	−.156**	0.002	0.061	−0.051	0.075	−0.001	.106**	0.004	−0.013	0.025	0.021	−.564**	1						
17. Medium firm	0.045	-.103**	0.034	-.130**	.124**	−0.033	−0.043	0.075	−0.017	.085*	−0.047	.090*	-.081*	-.114**	-.389**	-.162**	1					
18. B2B	−0.055	0.028	−0.025	−0.067	0.063	0.036	.086*	−0.009	0.044	0.021	0.032	−0.004	−0.046	0.039	−.102**	0.062	0	1				
19. B2C	0.061	−0.074	−0.034	0.028	0.006	−0.006	−0.017	−0.009	−0.036	0.001	−0.031	.096*	−0.058	−.136**	.082*	−.108**	−0.036	−.442**	1			
20. Attorney support	0.005	0.011	−0.069	−.145**	.106**	.143**	−0.036	0.024	−0.046	−0.023	.102**	0.016	−0.052	0.047	−.199**	0.013	.160**	.093*	−0.044	1	0	
21. Combination with patent	.308**	−.159**	−.087*	−0.060	0.058	.117**	0.036	0.066	−0.021	.151**	−0.028	.138**	−.196**	−.099*	−.119**	−0.026	0.071	−0.007	0.007	0.071	1	

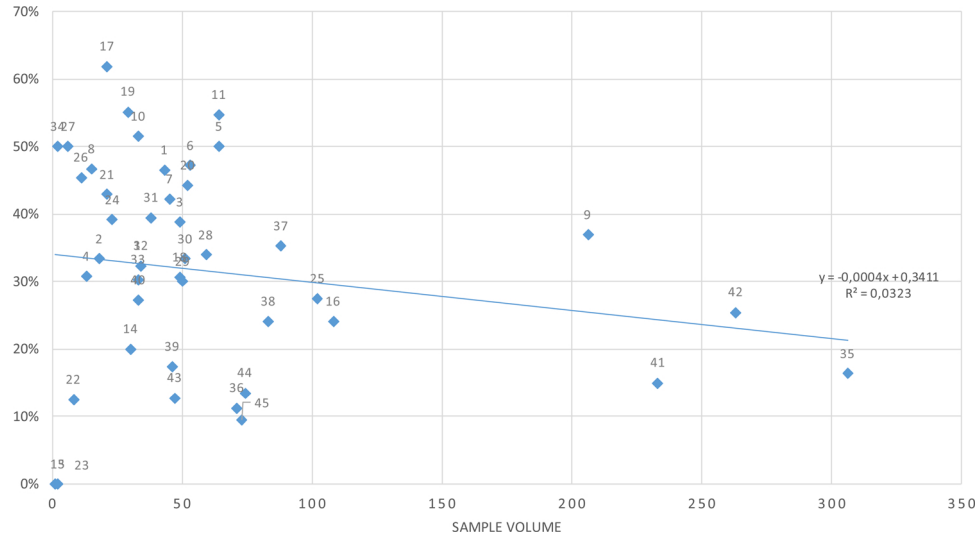

Fig. 3. Sample volumes versus the trademark relatedness to *product innovation* for all 45 Nice classes.

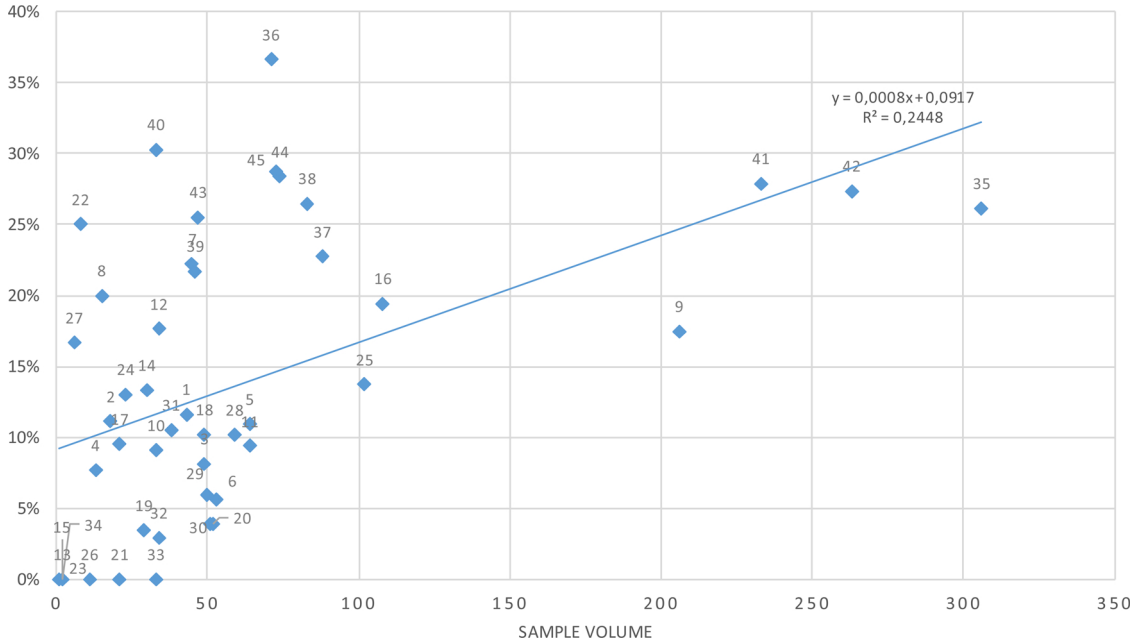

Fig. 4. Sample volumes versus the trademark relatedness to *service innovation* for all 45 Nice classes.

firms.

To explore the relationship between the distribution of the sample trademarks over the 45 Nice classes and the relatedness to innovation, we first mapped the two in an *xy*-plot for both product and service innovation (see Figs. 3 and 4). Univariate regression analyses showed a slightly negative relationship between sample volumes in the different Nice classes and the class-level relatedness to product innovation (R^2 = .032), and a positive relationship between the sample volumes and the class-level relatedness to service innovation (R^2 = .25). Fig. 4 shows a clear outlier in terms of relatedness to service innovation, namely class 36, covering insurance, financial, monetary and real estate services. Knowledge-intensive business services, of which financial services are a primary example, are often hailed as the most innovative among service firms (Barras, 1990). Moreover, trademarks have been shown to effectively capture their innovative output (Schmoch and Gauch, 2009). We included a dummy for this service class in the estimations and also added a dummy for the overrepresented product class 11 discussed in Section 4.2.

5.2. Hypothesis testing

We estimated the overall effect of our variables of interest on the probability that a trademark related to product innovation, service innovation or no innovation. After excluding the missing values listwise and selecting the set of observations for the multinomial regression (only trademarks referring to product innovation, service innovation, or no innovation), the actual number of observations used in the estimations was n = 656. There were notably very few cases of brand modernization in our sample, which prompted us to collapse brand extension and brand modernization in one category. This also made sense

Table 4
Multinomial logistic regression estimates, including and excluding the patent variable.

	Relatedness to:	Product innovation			Service innovation			Product innovation			Service innovation		
		B (including patent variable)	s.e.	p-value	B	s.e.	p-value	B (excluding patent variable)	s.e.	p-value	B	s.e.	p-value
Branding strategies													
Trademark design	First TM by startup	0.383	0.283	0.175	0.492	0.334	0.141	0.520	0.276	0.060	0.445	0.330	0.177
	Brand creating	0.345	0.267	0.196	−0.462	0.415	0.266	0.431	0.261	0.098	−0.449	0.409	0.273
	Brand extending/mod.	0.328	0.333	0.325	−0.166	0.515	0.748	0.510	0.321	0.113	−0.256	0.509	0.615
	Word mark	−0.014	0.315	0.965	0.915	0.376	0.015	0.028	0.311	0.927	0.822	0.371	0.027
	Figurative	0.022	0.405	0.956	2.072	0.559	0.000	0.081	0.396	0.838	1.921	0.549	0.000
	No. Words	−0.120	0.080	0.136	0.038	0.100	0.703	−0.117	0.077	0.129	0.032	0.098	0.741
Trademark scope	Geographic scope	−0.023	0.290	0.938	−0.911	0.377	0.016	0.089	0.283	0.752	−0.865	0.372	0.020
	Industry scope:												
	Nice breadth	−0.994	0.315	0.002	−0.403	0.357	0.259	−1.032	0.306	0.001	−0.405	0.358	0.259
	Only product Nice	0.165	0.291	0.570	−2.335	0.578	0.000	0.109	0.281	0.698	−2.236	0.569	0.000
	Only service Nice	−2.439	0.440	0.000	0.216	0.309	0.485	−2.545	0.436	0.000	0.279	0.306	0.362
	Popular Nice (9,35,41 or 45)	0.156	0.285	0.584	−0.269	0.391	0.491	0.101	0.275	0.713	−0.163	0.383	0.671
	Nice 36	−1.271	0.833	0.127	0.211	0.388	0.587	−1.283	0.796	0.107	0.239	0.385	0.535
	Nice 11	0.808	0.348	0.020	0.087	0.820	0.916	0.943	0.340	0.006	−0.201	0.810	0.804
Other properties (from survey/matched data)													
Firm size	Micro firm	0.546	0.334	0.102	0.384	0.562	0.495	0.435	0.320	0.174	0.307	0.554	0.579
	Small firm	0.581	0.350	0.097	−0.243	0.612	0.692	0.416	0.336	0.215	−0.292	0.605	0.629
	Medium firm	0.386	0.395	0.328	−1.297	0.917	0.157	0.353	0.380	0.353	−1.362	0.907	0.133
Firm market scope	B2B	−0.457	0.255	0.073	0.091	0.345	0.791	−0.474	0.249	0.057	0.123	0.341	0.719
	B2C	−0.060	0.224	0.790	−0.459	0.298	0.123	−0.103	0.218	0.636	−0.306	0.291	0.293
Other trademark properties	Attorney support	0.007	0.248	0.979	0.622	0.346	0.072	0.055	0.241	0.818	0.517	0.335	0.123
	Combined with patent	1.275	0.270	0.000	−21.433	0.000	n.a.						
	N	656 (of which 217 Product Inno., 89 Service Inno., 350 Non-innovation)											
	Nagelkerke R2	0.395						0.343					
	Percentage correct	Product Inn.: 42.9%, Service Inn.: 19.1%, Non-inn.: 80.9%						Product Inn.: 48.4%, Service Inn.: 11.2%, Non-inn.: 70.9%					

from a conceptual point of view, as both are trademarks that extend prior ones in a firm portfolio. The final sample also included relatively few cases of trademarks related to service innovation, of which very few combined with patents. This made the coefficient for the patent variable unreliable for the case of service innovation. At the same time, the estimated coefficient for the patent variable in the case of product innovation was strongly significant, its effect possibly overshadowing all other effects.

Table 4 shows both the estimations with and without the patent variable. The most striking difference between the two sets of estimations is that most variables capturing trademark design for branding only become significant after removing the patent variable. Since our goal is to uncover predictors that can be obtained from trademark records only, we focus on the results of the model without patent variable. Note that the model without the patent variable fits with the data nearly as well as the initial model including the patent variable. The prediction rate for product innovation is even slightly better (42.9% versus 48.4%). This means that our branding strategy approach delivers insights even in samples of patent-trademark pairs, which are anyway hard to construct.

Consistent with Hypothesis 1, first trademarks filed by startups and dissimilar subsequent trademarks filed for brand creation purposes by all firms were significantly more likely to relate to product innovation than the baseline category of first trademark by mature firms. The effect was stronger for first trademarks of startups: this result confirms studies by Block et al. (2014) and Vries et al. (2017), that emphasized the importance of trademarks for innovative start-ups. Instead, we did not find any support for Hypothesis 1 for the case of service innovation. Trademark design parameters did help to predict relatedness to innovation. Both figurative and word trademarks appeared to be related more strongly to service innovation than combined marks, with figurative trademarks relating strongest to service innovation. Because new services cannot be 'packaged' differently in the physical sense, figurative marks might function as ways to repackage services. Trademarks with more words, hence more likely to be slogans, were less related to product innovations, but not significantly so.

As for Hypothesis 2a, the geographic scope of a trademark did not significantly affect a trademark's relatedness to product innovation, hence the evidence did not support this hypothesis. Instead, we found support for Hypothesis 2b, as CTMs related less strongly to service innovation.

In line with Hypothesis 3a, narrower trademarks in terms of Nice classes breadth were more likely to flag specific new products than broader ones. This effect was there only for product innovations. As for Hypothesis 3b, the results indicated a strong effect for both product and service innovation: product (service) only marks related significantly less often to service (product) innovation than trademarks covering both product and service classes. In this sense a specific industry scope helped to predict which trademarks were *not* likely to refer to a specific innovation type. Hypothesis 3b was then not confirmed in its original form. Particularly Nice class 11 was useful to predict product innovation.

In terms of our controls, we did not find a clear effect of firm size, but a negative effect of the B2B variable, indicating the trademarks from companies active in B2B segments related less often to product innovation than those from companies other segments (B2C and B2NP), which confirms the expectation by Malmberg (2005). Attorney support played a minor positive role for trademarks related to service innovation. Finally, as expected the combination with a patent is a strong predictor of relatedness to product innovation, but the other significant effects remain in the model without patent variable.

Overall, the models have a reasonable goodness of fit (Nagelkerke R^2 = .395 and .343) and prediction rates were higher for the non-innovation category. This means that it was easier to figure out which trademarks did not relate to innovation, while it was trickier to predict the relatedness to product and service innovation. Nevertheless, for both innovation types, significant effects were found, coming from specific elements of the underlying branding strategies.

6. Conclusions, discussion and future research

Research using trademarks has so far mostly exploited information on the sheer counts of trademarks without delving into a qualitative assessment of the underlying trademark portfolios and the information contained in individual trademark records. Our study showed the value of a branding strategy approach to the identification of trademarks related to innovation. Based on our large-scale study of 2009 BTM and CTM registrations we found some striking differences between product and service innovation.

First, new trademarks related more frequently to product innovation than to service innovation. This confirmed results of the study by Flikkema et al. (2014), even though our sample was biased to some extent towards manufacturing firms. The lower relatedness to service innovation may also be explained by the fact that it is relatively easy to start a (one-person) business in service industries. Many of those business may be non-innovative and apply for trademarks in the popular Nice 35 class, with the aim to distinguish themselves via trademarks from other non-innovative firms.

Second, trademark application for brand creation purposes related positively to product innovation. This held in particular for brand creation in startups. We could not confirm the same for service innovation. A plausible reason may be the supplier dominance in many service firms' R&D processes (Flikkema et al., 2007), which might lead to delivery innovation and less frequently to the introduction of new service concepts with a clear brand story. Alternatively, the lack of results might also have to do with the complexity of conceptualizing service innovation (Hertog, 2000), leading to respondents' confusion in identifying what counts as a service innovation.

Third, trademarks with a narrow industry scope significantly predicted product innovation, while a narrow (i.e. national) geographic scope contributed to the prediction of service innovation. The current pricing of trademark applications in both jurisdictions and broad Nice service classes may have hindered a more accurate investigation of the relationship between a trademark's industry scope and innovation. The dichotomization of geographic scope, and relatively small domestic markets in the Benelux, may have hindered a more accurate investigation of the relationship between a trademark's geographic scope and innovation. Further research could replicate our analysis of trademarks applied for at a national office with a proportional pricing policy, like the USPTO. From 2019 January 1st onwards in the Benelux jurisdiction applicants have to pay a fee for every Nice class covered also. We will therefore try to replicate our study in the Benelux, and also in large EU member states, in the years to come.

Our study suffered from some limitations. First, although we did some validation of the reported data, we have not validated the self-reported relatedness to innovation. For example, entrepreneurs might be unacquainted with the industry they are entering and therefore overrate the newness of the products or services they have developed. In addition, some unpatented innovations might be wrongly qualified by respondents in one of the categories not related to innovation, as a consequence of their belief that patent application is a precondition for innovation. This bias might be particularly relevant for startup firms and in service contexts, as discussed earlier, which could explain why we did not find the expected relatedness of first trademarks by startups to service innovation. Second, in the survey trademark applicants self-reported whether they were a startup or a mature firm, without further specifications about the two categories. There might be differences between industries and countries concerning the interpretation of the

startup concept. This may have led to an overrepresentation of startups in our sample for some industries, particularly for high-tech industries. As a consequence we might have underestimated the effect of trademarks filed for brand creation in startups somewhat, because according to our H1 one would expect first trademarks to be strongly related to innovation.Third, we focused here on two types of innovation only (product and service) and only on cases where those did not overlap. In reality, many innovations increasingly combine product and service elements, often as the result of servitization paths whereby product firms develop solutions following a service logic (Cusumano et al., 2015). These innovations, often referred to as business model innovation (Desyllas and Sako, 2013) would also be relevant to study. Our branding framework could be applied to those instances as well, but the research design for a new empirical study would have to be modified to select relevant cases.

Based on our study results, we propose four avenues for future research. First, the method for qualifying trademark filing strategies proposed by Sandner (2009) did not seem to be fully accurate for qualifying an applicant's branding strategy. Not only because the approach only took verbal similarity between trademarks into account besides the overlap of industry scope; also because firms can use different trademarks on their product packaging. We therefore stress once more the importance of making a conceptual distinction between trademarks and brands. Dissimilar trademarks may serve different branding purposes, ranging from brand modernization to brand creation. Future, micro-level research should reveal when the application of dissimilar trademarks happens for brand creation, extension or even modernizing purposes. We expect most differences in B2C retail markets, where packaging is an important element of the marketing mix (see Rettie and Brewer, 2000; Ampuero and Vila, 2006).

Second, we have to put more research effort in reconstructing the branding motives of mature firms that filed their first trademark relatively late. We found a substantial share of first trademarks from mature firms in our study, but could not reconstruct their underlying branding strategies. One reason could be that their trademark filing is not driven by strategic but myopic motives (Castaldi, 2018). We tend to think that also for policy reasons it would be beneficial to better understand the late first trademark behavior. Characteristics of these applicants might be used to provide similar firms with information about the possibility to protect their brand logos.

Third, we propose to study with larger samples the consequences of different combinations of industry and geographic scope for the trademark relatedness to innovation, particularly for service industries and applicants with a large domestic market, such as France, Spain or the US. Similarly, we propose conducting studies into the firm-level, regional-level and industry-level *propensity* to trademark innovation. Nearly all recent studies on the trademark-innovation relatedness start with trademark data and aim to test whether trademarks are a valid indicator of innovation. They study proportions of new trademarks that relate to innovation. However, for policy reasons, it is also highly relevant to understand inter and intra industry differences concerning the propensity to trademark innovation (see Arora et al., 2016). This would require focusing on samples of innovators or innovations only, in order to study differences in the use of trademarks to protect or flag innovations. Fourth, the need of matching trademark data with patent data has become less stringent, because a branding strategy approach to the identification of trademarks related to innovation largely substitutes the need for it. Still, initiatives may be valuable to develop heuristics and algorithms to match trademark data with other IPR data, for example design rights and growers' rights, and economic data. Such combinations of data will definitely improve our understanding of how to measure innovation and eventually clarify the performance consequences of different innovation types and IPR strategies. Note that EUIPO, the OECD and the European Patent Office (EPO) already have some experience matching trademark and patent data (OHIM, 2013; Thoma and Torrisi, 2007). Zolas et al. (2017) have worked on an algorithm for matching trademark data and economic activity data. Yet, current attempts mostly involve matching trademarks and patents at the firm level, while it remains difficult to have a matching at the product level. As long as this information is not available, information from trademark records themselves can offer a viable solution. Our study has shown that exploiting the information from trademark records can offer significant predictors of trademarks' relatedness to innovation.

Declaration of interests

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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